

GPS almost always refers to the NAVSTAR system, which was developed and is maintained by the US Department of Defense. The first experimental satellite was launched in 1978; by late 2012, the system included thirty-two satellites, positioned in precise orbits approximately eleven nautical miles above Earth, that continuously broadcast radio signals. A GPS receiver picking up signals from four satellites can compute its location anywhere on the globe. The satellites broadcast a separate code for military use, and the US military can jam the civilian signal to selected areas.

GPS depends on the accurate maintenance of the satellites, signals, and related control systems—all of which are entirely under the control of the US government. The United States deliberately degraded the signal available to civilian users until May 2, 2000, but a full-precision civilian signal has been available to all users since then. The United States says that it intends to maintain free worldwide access to the signal and has continuously upgraded the system. As a result, GPS is increasingly an international utility provided by one nation, although other countries are developing alternative systems.

GPS itself is an inert provider of locational data. To be used as a tracking device, it must be linked to a communications system. GPS-based technology can be used to monitor the movements of people, including children, Alzheimer's patients, and criminals, as well as personal and fleet vehicles. On a more widespread scale, GPS functionality is now incorporated into many mobile electronic devices, partly in response to a 2002 directive from the US Federal Communications Commission that cell phones should be locatable in case of an emergency call. When the technology is enabled, these devices continuously broadcast the location of the user, which allows third parties, such as vendors or emergency managers, to immediately transmit place-specific messages. It also creates the opportunity for covert monitoring and surveillance. There are significant ethical and legal questions surrounding the right of individuals to personal locational privacy and the requirements for warrants and informed consent.

GPS is an essential component of modern intelligence gathering and warfare. Combined with communications and geographic information systems, GPS provides comprehensive information on the location and movement of individuals, groups, and assets, and allows accurate targeting of missiles. Some people have ethical concerns about the military applications of GPS, while others argue that accurate location information lowers collateral damage in warfare.

GPS has evolved from a military system into a widely used global utility, although the basic signal remains available at the discretion of the US National Command Authorities. Individual jurisdictions have yet to decide

acceptable parameters for the use of data derived from the GPS signal.

SEE ALSO *Aviation Regulatory Agencies; Geographic Information Systems.*

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GLOBAL RESEARCH COUNCIL

At least since the formation of the Royal Society in 1660, science has envisioned itself as a global enterprise. Science is often touted as neutral territory concerned with the pursuit of truth independent of political or other biases. All scientists, on this view, share a common *ethos*, regardless of country, creed, race, or gender. With the increasing globalization of science, however, cultural differences between scientists from around the world have been recognized as an increasing problem (Suresh 2011).

ORIGINS

The Global Research Council (GRC) was launched as the result of a meeting, the Global Summit on Merit Review, convened by the then director of the US National Science Foundation (NSF), Subra Suresh, and hosted by NSF from May 13 to 15, 2012. The GRC describes itself as “a virtual organization, comprised of the heads of science and engineering funding agencies from around the world, dedicated to promoting the sharing of data and best practices for high-quality collaboration among funding agencies worldwide.” The stated purposes of the GRC are:

1. To improve communication and cooperation among funding agencies;
2. To promote the sharing of data and best practices for high-quality research cooperation;
3. To provide a forum for regular meetings of the Heads of Research Councils;
4. To respond to opportunities and to address issues of common concern in the support of research and education;
5. To be a resource for those institutions wishing to build a world-class research landscape; and
6. To explore mechanisms that support the global science enterprise and the worldwide research community.

In order to achieve these goals, the GRC has adopted a procedure of holding topical meetings focused on issues of concern to funding agencies around the world, especially in light of an increasingly globalized scientific enterprise. These meetings have included regional meetings leading up to full meetings of the GRC.

ANNUAL MEETINGS

At the Global Summit on Merit Review, which was, in essence, the first global meeting of the GRC, almost fifty funding agency heads endorsed a *Statement of Principles for Scientific Merit Review* (GRC 2012). These principles include articulation of the values of expert assessment, transparency, impartiality, appropriateness, confidentiality, and integrity and ethical considerations.

The choice of peer review (*merit review* is the term used by NSF for its peer review process for grant proposals) as the first topic for the GRC is notable for several reasons. First, the choice reinforces the idea that peer review is central to the practice of science, as well as to the operation of funding agencies (Suresh 2012). Second, despite the fact that peer review practices at different funding agencies—and often within funding agencies—vary (Holbrook 2010; Holbrook and Hrotic 2013), the GRC arrived at a set of high-level principles meant to guide peer review practices across all funding agencies (GRC 2012). Finally, the procedure for developing the principles was explicitly oriented by the value of achieving a *consensus on standards* for peer review.

The second Annual Meeting of the GRC took place in Berlin from May 27 to 29, 2013, and was attended by heads of around seventy research funding councils, as well as “high-ranking guests from science and research, science administration and research policy” (GRC 2013a). Two topics were addressed at this meeting: *open access* and *research integrity*. In addition, attendees discussed new statutes for the GRC itself.

The 2013 GRC meeting participants endorsed an *Action Plan towards Open Access to Publications* that affirms the need for science to move toward open access (OA)—free online access to research products (see the entry on “Open Access” for a more limited definition of the term)—“steadily and as swiftly as possible” (GRC 2013b, 6). To that end, the plan outlines three broad steps: (1) raising awareness of OA within the research community; (2) promoting and supporting OA; and (3) assessing the implementation of OA. The document also addresses differences among research councils and the need to engage a broad range of stakeholders in revisiting the *Action Plan*, which is described as “a living document” (GRC 2013b, 1).

The GRC *Statement of Principles on Research Integrity* opens with the claim: “The Responsible Conduct of Research is at the very essence of the

scientific enterprise and is intrinsic to society’s trust in science” (GRC 2013c). The document also notes that, although performing research with integrity is ultimately the responsibility of the researchers themselves, funding agencies also have responsibilities regarding research integrity. These include:

- *Leadership*. Research funding agencies must lead by example in the responsible management of research programs.
- *Promotion*. Research funding agencies should encourage institutions to develop and implement policies and systems to promote integrity in all aspects of the research enterprise.
- *Education*. Research funding agencies should promote continual training in research integrity, and develop initiatives to educate researchers and students on the importance of research integrity.
- *Transparent Processes*. Research funding agencies should, within the scope of their mandate, publish policies and procedures to promote research integrity and to address allegations of research misconduct.
- *Response to Allegations of Misconduct*. During any investigation of misconduct, research funding agencies should support a process that values accountability, timeliness, and fairness.
- *Conditions for Research Support*. Research funding agencies should incorporate integrity in research as a condition for obtaining and maintaining funding by researchers and institutions.
- *International Cooperation*. Research funding agencies will work cooperatively with partners to support and facilitate research integrity worldwide. (GRC 2013c)

This endorsement of principles regarding the responsibilities of funding agencies with regard to research integrity and responsible conduct of research (RCR) is the first to establish global standards for funding agencies.

FUTURE PROSPECTS

The third Annual Meeting of the GRC was scheduled to take place in 2014 in China, hosted by the Chinese Academy of Sciences (CAS) and the National Natural Science Foundation of China (NSFC), with the Natural Sciences and Engineering Research Council of Canada (NSERC) serving as cohost.

The GRC has the potential to influence the future course of scientific research across the globe. Its *Statement of Principles on Research Integrity* is a move that has the potential to nudge particular science policies around the world in the direction of RCR and ethics education requirements. This statement is especially significant when

one considers that NSF adopted such a requirement as recently as 2009. The GRC's *Statement of Principles for Scientific Merit Review*, on the other hand, is likely to have most influence on those funding agencies in countries without a strongly established culture of peer review. It remains to be seen, for instance, whether the GRC's statement can assist NSFC with its efforts to promote the wider adoption of such a culture within China (see Frodeman et al. 2012).

That the GRC tackled the issue of OA is interesting for several reasons. First, OA is fraught with difficulties not associated with, say, the issue of research integrity. Where it is easy for everyone to agree that research needs to be performed with integrity, it is a matter of considerable controversy whether research results should be made freely available. Some stakeholders in the process, such as scholarly publishers, are opposed to the idea of OA unless an alternative business model can be adopted that would allow them to continue to profit from publishing. There are also issues of social justice and intellectual property associated with OA. Might global OA cause shifts in national science funding budgets? If the results of research are freely available, why not let other countries pay for the research? Some countries have defied intellectual property laws out of humanitarian concerns. For instance, companies in India reverse engineered a drug cocktail for treating HIV/AIDS, which they made available to consumers for a fraction of the cost of drugs manufactured in the United States. The United States objected on the grounds of patent infringement. Could the GRC's attempt to establish global standards for OA be seen as an attempt to enforce either social justice *or* intellectual property laws?

There are several logistical issues the GRC must address in the future, including:

- Who should determine the topics to be addressed by the GRC?
- Will the GRC do more than issue high-level statements? Will the GRC enforce any mandates?
- Will the GRC itself become a global funding agency? If so, how will money be invested and distributed?

Finally, there is the question of consensus. As it has operated in the past, the GRC has attempted to synthesize various funding agency opinions to arrive at a consensus statement. On issues such as research integrity, this may be a wise strategy. However, with more controversial topics, consensus should not always necessarily be presumed as the correct end. Moreover, aiming for consensus raises further questions: When and to what extent should the GRC involve stakeholders beyond heads of research councils and important policy actors? How might other stakeholders participate in the GRC's deliberations? What is, after all, the proper role for principles in policymaking (Holbrook and

Briggle 2014)? Answers to questions such as these will determine the future direction of the GRC.

SEE ALSO *Intellectual Property; Interdisciplinarity and Collaboration; Neoliberalism and Science; Open Access; Science Policy and Public Science Agencies, South American Perspectives; Science Policy and Public Science Agencies, Southeast Asian Perspectives; United States National Aeronautics and Space Administration; United States National Institutes of Health; United States National Science Foundation.*

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GLOBAL WARMING

SEE *Global Climate Change.*